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What's in the Water? *Escherichia coli* bacteria in Tanyard Creek and Lilly Branch Watersheds at the University of Georgia

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Introduction

Tanyard Creek and Lilly Branch

Tanyard Creek and Lilly Branch are tributaries of the North Oconee River and part of the Upper Oconee River Watershed that flows eventually into the Atlantic Ocean [1]. Both creeks' headwaters begin just west of the University of Georgia campus, then flow through UGA campus and finally end in the Oconee River on the Southeast part of campus [1]. Most of Tanyard Creek and Lilly Branch are surrounded by urban areas, leading to many anthropogenic influences on the water quality.

***E. coli* as an indicator for fecal coliform**

One of the best indicator species for water impairment from fecal matter is *Escherichia coli,* or *E. coli*. *E. coli* are bacteria found in the intestines of mammals and are excreted in mammal feces [2]. Because of its presence in animal feces, *E. coli* is used as an indicator for fecal coliforms, that is, other bacteria in animal and human waste that threaten public health [3]. High concentrations of *E. coli* in water streams, rivers, and lakes are indicative of contamination by human and/or animal feces.

Tanyard Creek impairment

Tanyard Creek is on the EPA list of impaired waterways and the primary cause of its impairment is fecal coliform [4]. Our data show that the levels of *E. coli* bacteria in Tanyard Creek are much higher than the EPA limit for safe recreational use which is 410 coliform forming units (CFU) per 100 mL. The levels of *E. coli* in Lilly Branch, however, are only slightly higher than the EPA limit.

Methods

Figure1: Collection of water samples from Tanyard Creek. Photo Credit: Ridwan Bhuiyan.

Water samples were collected from Tanyard Creek and Lilly Branch.

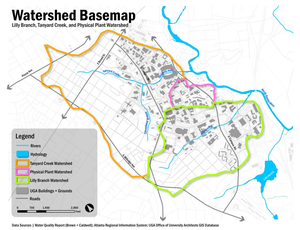

Figure credit: 9-Element Watershed Management Plan for the North Oconee River: Tanyard Creek to Lilly Branch [1] .

Figure 2: Analysis of water samples at UGA Environmental Health Science laboratory. Photo Credit: Keri Lydon.

Samples were brought back to the lab and analyzed immediately.

Procedure:

1.Gather m-TEC agar plates.
2.Set up membrane filtration device and place sterile filter on suction funnel.
3.Starting with lowest volume of sample, filter the water by membrane filtration to collect the bacteria.
4.Place filter on mTEC plate and put in incubator for 2 hours at 35°C and then at 44.5°C for 24 +/- 4 hours.

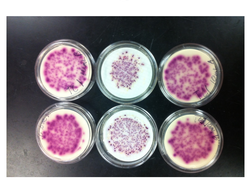

Figure 3: Petri Dishes showing *E. coli* bacteria colonies from Tanyard Creek water samples. Photo Credit: Tiffany Eberhard

After the 24 hour growth period, determine the number of *E. coli* by counting the purple colonies. Each dilution count is multiplied to get the CFU/100 mL.

Results

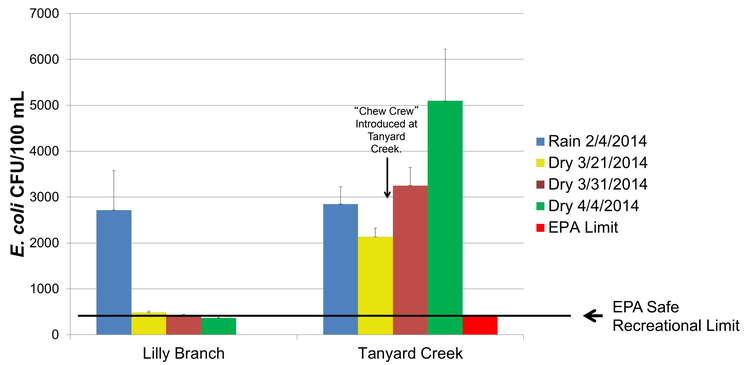

Figure 4: *E. coli* levels on dry and rainy days in Tanyard Creek and Lilly Branch. Average coliform forming units (CFU) per 100 mL of water +/- S.D. from at least three samples per day taken on the days indicated.

The level of *E. coli* was significantly higher in Tanyard creek than the EPA limit. The highest *E. coli* CFU/100 mL at Tanyard Creek was 5100 measured on 4/4/14. The other levels at Tanyard Creek were 2850, 2133, and 3250 CFU/100 mL, all of which were also much higher than the EPA safe recreational use limit (410 CFU/100 mL). The Tanyard Creek "Chew Crew" goats began grazing along the measured portion of stream on 3/25/14. The CFU/100 mL at Lilly Branch were much higher when measured on rainy days than on dry days. The rainy day level reached 2717 CFU/100 mL *E. coli* while the dry day levels were 483, 398, and 368 CFU/100 mL. After or during a rain it is common to see higher pollutant levels, including *E. coli*. This is apparent in Lilly Branch where the levels of *E. coli* were almost five times greater on rainy days.

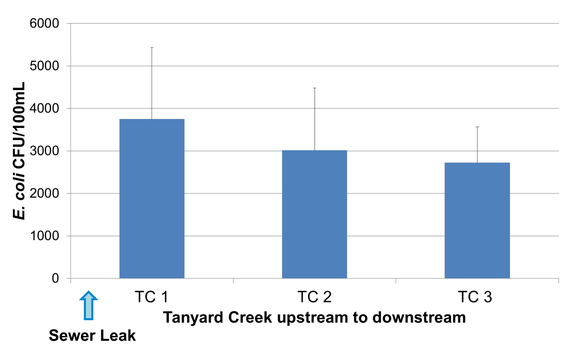

Figure 5: Comparison of *E. coli* levels upstream versus downstream. Average +/- S.D. of *E. coli* CFU/100 mL of water from four days of samples from Tanyard Creek (TC). Samples were taken at three locations, TC 1 is upstream, TC 2 is midstream, and TC 3 is downstream.

Water samples were taken from Tanyard Creek between Baxter Street and Hull Street, next to the "Chew Crew" and the Hull St. parking deck. TC 1 was the furthest upstream and TC 3 was the furthest downstream. The average *E. coli* level at TC 1 was 3750 CFU/100 mL, at TC 2 was 3012 and at TC 3 was 3012 CFU/100mL. There is a sewer leak in Tanyard Creek upstream near TC 1 and further research needs to be conducted to see whether it contributes to the *E. coli* contamination in Tanyard Creek as the data suggest [4]. We hypothesize that the sewer leak is a point source for fecal bacteria contamination into Tanyard Creek.

Conclusions

- Tanyard Creek had continuous high *E. coli* bacteria counts, whereas Lilly Branch showed especially high numbers after a rain.
- Possible sources for high contamination in Tanyard Creek:
  1. A sewer leak (point source) near the upstream portion of Tanyard Creek [1].
  2. The "Chew Crew" is a group of goats that live along the creek with the mission to eat the invasive plant species so that the native flora can grow back. Feces from the goats could cause fecal coliform contamination in the creek.
  3. Runoff from roads, lawns, and other areas often contain chemicals, nutrients, bacteria, and other sediment that can increase levels of contamination [1].
  4. Pollutants in water from storm drains flow directly into the watershed.
- Efforts to clean the UGA campus watershed are underway:
  1. Education and outreach
  2. Identifying illegal discharges
  3. Remediation research
  4. Repairing leaks in the sewer system
  5. Decreasing runoff contamination through infrastructure changes and education

Future Research

- Determine the extent to which the sewer leak is contaminating Tanyard Creek by further analysis near and downstream of the leak.
- Work with county officials to find and fix the sewer leak and monitor Tanyard Creek fecal coliform levels after it is fixed.
- Develop strategies to identify fecal coliform sources around waterways on the UGA campus and decrease fecal contamination.
- Implement plans to educate the community about the UGA watershed and ways to keep it clean.
- Continue research on the effectiveness of the "Chew Crew" and the goats' effects on Tanyard Creek.

Image 6: The "Chew Crew" goats at Tanyard Creek. Photo Credit: Tiffany Eberhard

Literature Cited

1. "9-Element Watershed Management Plan for the North Oconee River: Tanyard Creek to Lilly Branch." (2012). http://sustainability.uga.edu/wp-content/uploads/2012/08/UGA-Watershed-Management-Plan-2013.pdf
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